large proportion of instances. But if such treatment do not fully relieve the dypnœa, it will, I think, in most instances, so diminish it and retard the progress of croup, that the physician, remote from help and unfavorably situated for the performance of tracheotomy, will have ample time to prepare for this operation. We repeat, that intubation may prevent the need of tracheotomy, but if it do not, it presents no hindrance to it. We have stated above that in one of Bouchut's cases the house staff, alarmed by the dyspnœa of a patient who was carrying the laryngeal tube, which had probably become obstructed, performed tracheotomy without disturbing the tube. The longer tube of O'Dwyer might, perhaps, serve as a guide in tracheotomy, but it can be quickly removed, if thought best, before the operation is commenced.

ABNORMAL VISUAL SENSATIONS.

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With increasing knowledge and improved methods of diagnosis, most of the cases formerly classed as amaurosis or amblyopia are now relegated to their proper position in the list of more definite diseases of the eye; but meanwhile slight errors of vision, which were formerly unheeded, have been brought into notice, some of them only within the last year or two. Amblyopia thus continues to be a generic term, including all cases of dull sight in which no distinct lesion of the eye can be discovered; it expresses, in a general way, the failure in function without indicating the pathological condition present. Subdivisions have been made according to the assumed cause of the affection; the assumption in some cases is supported by the strongest possible evidence, as in tobacco amblyopia; while, as more light is thrown upon the subject, the term hysterical amblyopia becomes less frequently used.

The essential symptom is a partial or complete absence of perception, either of objects or colors, in some part of the visual field; the function is impaired or modified. A normal visual acuity varies with illumination; it is certain, therefore, that some amblyopias will be much modified by the amount of light.

It is convenient to classify the cases according to the part of the visual field which is chiefly affected; but at the same time the evidence that has been derived from the pathological conditions present in those examined indicates that the position of the lesion is fairly constant for similar conditions of the visual field. In some a well-defined organic mischief has been shown to be present, either in the peripheral nerve terminating in the retina, in the cerebral centres, or in the optic fibres connecting these; in others a definite cause exists for initial vascular disturbance of the nervous elements of the retina.

The main affection of the visual field may be at the periphery, at the centre, or in one half: "concentric amblyopia," "central amblyopia," "hemiopia."

1. *Concentric limitation of the field of vision* exists whenever the general function of the retina is impaired; for instance, after "injury;" in "retinitis pigmentosa," where the effect of dull light is very marked (other forms of retinitis are complicated by hemorrhage); and in increased "eyeball tension."

In "reflex amblyopia" (Priestley Smith, *Ophthal. Rev.*, 1884), where some distinct irritation of sensory nerves affects the retinal circulation, it is the circumference of the field that is most blurred in many cases. The removal of the uterine appendages by abdominal section effected the recovery of useful sight in an eye which, up to the very day of operation, was increasingly threatened with blindness; the withdrawal of a tooth is said to have restored sight to an eye formerly blind; and a similar cure has followed free purgation. The retinal fatigue which accompanies general nervous weakness ("neurasthenic asthenopia," Wilbrand), whether expressed by anæsthesia or hyperæsthesia, is best marked at the limits of the field, as is the case also with "hysterical amblyopia," which is almost always either neurasthenic or reflex.

The concentric limitation of the field depends on functional weakness of the periphery of the retina, due to failure in its circulation; no definite abnormal appearance of the fundus oculi can be seen, although hyperæmia or slight œdema may have been described. Marked retinal asthenopia may be present without any appreciable alteration in the disk or in the retinal bloodvessels; but it must be remembered that the rods and cones derive their blood from the "chorio-capillaris," whilst the "arteria centralis retinæ" supplies the less vital fibres and large cells. Moreover, the chorio-capillaris which lies upon the hexagonal pigment cells has its network closest and richest for blood supply at the yellow spot, whilst it becomes gradually more open toward the ora serrata. The anterior parts of the outer more active retinal layers would thus be earliest affected by any conditions producing vascular depression.

Concentric amblyopia depends probably, therefore, upon malnutrition of the bacillary layers of the retina by failure of the circulation in the chorio-capillaris.

The circulation in each eye is separate entirely from that of its fellow; each has its own special sympathetic control. The importance of the circulation through the arteria centralis retinæ must not be underrated, for its blockage is followed by complete blindness in the affected eye, while occlusion of one of its branches destroys the function of that segment of the retina to which it is supplied.

2. *Hemiopia* in one eye may thus result, the line of separation being usually horizontal. Interstitial inflammation of a part of one optic nerve may cause a like segmental defect. A medical friend has complete scotoma in the lower field of the left eye; the central vision presbyopic is J. 16 and $\frac{20}{\text{XLV}}$ compared to $\frac{20}{\text{XXXV}}$ and J. 16 in right; no retinal abnormity can be detected by the ophthalmoscope; the retinal blood-vessels are everywhere normal; but the whole optic disk is distinctly white.

Hemiopia is usually binocular, and depends on intracranial lesion, and conversely intracranial mischief of the optic tract or centres produces binocular hemiopia; for, by reason of the symmetrical binocular arrangement of the nerve system of the eyes, *each side of the brain is represented on that same side in both eyes.* A right cerebral lesion causes impairment of the right half of each retina, with amblyopia in the left field. Samuelsohn has described a case of binocular hemiachromatopsia, the other eye symptoms being normal, in a patient with hemiplegia from apoplexy; Swanzy a somewhat similar case. Conversely, *each eye is represented in both sides of the brain.* In hemiopia, central vision is frequently normal; each macula is supplied by both optic tracts. This anatomical arrangement may explain cases of monocular diplopia; in most of those recorded, cerebral lesions have been found after death. Dr. Abercrombie has suggested that the impressions transmitted from the single retina to its two sides in the brain are interfered with by the presence of the lesion; and the two hemispheres not acting in perfect unison, a concept is created of two separate impressions. Where monocular homonymous diplopia has followed after ordinary binocular homonymous diplopia from paralysis of an external rectus, Nettleship thinks that the diplopia of each separate eye may be a mental reproduction of the diplopia experienced by the distorted pair. When both eyes are affected with monocular diplopia, there is usually a great similarity in the relative position of the images as seen by each separate eye. Sometimes the position of the images is such as to suggest an absolutely symmetrical affection of the retina in each eye. Monocular diplopia may affect one eye only, or may exist in only the outer field of one eye (Brailey). A converse condition of things has lately been described by Wolffberg, viz., a blending of two separate but similar objects lying close together into one image, whether looked at with the two eyes or with one singly. The position of the lost image was not recognized as a defect in the visual field. The pathological cause of this illusion is not suggested; possibly some of the retinal nerve endings are not properly represented in the higher visual centres.

3. While hemiopia depends usually upon some disease on the cerebral side of the optic chiasma, central amblyopia may be generally associated with a lesion in the optic nerve or in its retinal expansion. A well-marked central scotoma may be present, or only a very slight error of the color sense. The detection of the slighter defects depends on the care and capacity of the observer; and, while one may explain the symptom by describing a diffused grayness, an œdema, or small white specks in the macula, another may entirely fail to find anything wrong. Tiny hemorrhages may be overlooked. When they exist at the papilla, they are suggestive of a similar condition deeper in the nerve. In typical cases it is admitted that ophthalmological evidence of changes in the fundus are absent. In many a toxic causation is fairly assumed. Tobacco, alcohol, bisulphide of carbon, lead, quinine, have all been admitted as causes, in addition to kidney disease and diabetes.

I have under treatment a man of forty, with typical tobacco amblyopia, who has been a teetotaller for twenty years. Most excessive smokers also drink, perhaps not to excess. The efficacy of alcohol in preventing tobacco blindness may be questioned, but it is easier to induce the patient to abandon tobacco if a little stimulant is still permitted. I have seen one or two cases of dull central green perception in women which I have attributed to alcohol. A gentleman of forty, who had suffered from albuminuria for some years, but without any other evidence of disease, consulted me for failure of sight. Central vision was reduced one-half; there was a well-marked red scotoma and a total absence of green perception under several tests. The fundus of the eye showed no albuminuric signs; nothing but some pallor of the disk. The patient smoked and drank liberally, but not to great excess; at the same time he slept badly and ate little. Reduction of both smoke and drink soon markedly improved his condition, but I do not know whether the eyesight has recovered.

Post-mortem examination of patients who had central amblyopia has shown that a neuritis with marked interstitial inflammatory changes existed in the axial fibres of the optic nerve. In some of them the brain lesion lay opposite the optic foramen, where the nerve is constantly subjected to pressure against the bone and by the ophthalmic artery. The bloodvessels of the nerve, quite distinct from the retinal and choroidal arteries, pass in at the surface of the nerve and become more and more divided as they approach its central fibres. The finest capillary plexuses which have the highest functional activity, and are therefore specially prone to inflammation and pathological changes, are distributed to the central axial fibres which are the most highly vital, and pass into the macula lutea. Thus the part of the optic nerve which is concerned in central vision is specially liable to hyperplasia and sclerosis.

Central scotoma is well known as a result of gazing at the sun; in extreme cases the ophthalmoscope may show a small white spot at the centre of the macula, surrounded by a red ring. Near exposure of the eye to a strong electric light produces impairment of the retina, followed in a few hours by inflammation of the eyes; snow blindness is accompanied by similar symptoms. Excessive stimulation of the retina is more diffuse, in the latter cases implicating the whole membrane; in the first the macula is mainly affected.

Well-defined structural changes have been found in the eyes of rabbits which have been exposed to excessive sunlight; microscopic examination showed disorganization of a limited area of the retina by coagulation of its albumen, and beneath and around this hyperæmia and exudation in the choroid. The ophthalmoscopic appearances in man are such as might be dependent on the like histological changes in the macula. Inflammation of the yellow spot with swelling and separation of the retinal elements may be a cause of micropsia; a diminished number of the cones, and these the more central, are overshadowed by the retinal image, and the contracted area of the stimulation produces a relatively limited mental impression. Diminution in the apparent size of an object has been also explained by Bensen in a case of ophthalmoplegia interna, as dependent upon the extra muscular strain needed by a weakened ciliaris, this giving an idea of undue approximation of the object, and so of its relative diminution in size.

Metamorphopsia probably results from an altered relation of the macular elements. Straight lines seem bent and crooked; part of an object is too small, part too large (megalopsia); separate objects in the visual field may be perfect, but their relations to one another contorted and untrue. The letters of a word may be seen in front of and some behind the level of the paper on which they are printed.

In these complicated visual errors it is impossible to say what part the mind plays, or how much they are dependent upon the condition of the eye.

Visual hallucinations, properly so-called, which are purely dreams of the imagination, dependent on abnormal conditions of the highest physiological cerebral centres, subjective in themselves, and not dependent upon stimulation or alteration of their afferent nerve tracts, are probably extremely rare during hours of wakefulness. Such a case is described in the appendix to *Huxley's Physiology*. The dreams of sleep usually are excited by some external stimulus. An illusion or modified sensation may depend upon exhaustion or mischief in the central organ, or may arise from perversion of the stimulus received upon a faulty peripheral sense organ.

The brain is affected in such a case as that of the Hon. Mr. Perceval, who mentions that, on the commencement of his insanity, while looking at a boiled fowl which was prepared for his dinner, it appeared very large and plump, then it suddenly became small and meagre, and afterward of twice its former size. So, in watching a fellow patient, who was one day walking in the airing ground, he observed at one part of the walk that this man suddenly changed in shape, and walked into the house under the form of a demon. The illusion from the same object is, therefore, not always fixed and permanent, but subject to momentary changes.

Two cases have come under my observation in which seeing imaginary faces in the day has been associated with retinal disease, and it is possible that in them the diseased sense organ may be largely answerable for the illusory appearances.

Case I.—Miss M., aged fifty-five, consulted me for asthenopia: "objects seem strange and distorted, faces are looking at me on opening my eyes after having closed them for relief or sleep." She had always been short-sighted. Had a slight seizure three years before of both hands, with transient difficulty in choice of words. For two years both eyes had regularly seen a blaze of gold light on the street lamps surrounded by halos of green, red, and purple. Sight had been dull also, the electric light not seeming to her specially bright.

Vision of left eye $\frac{5}{\text{xxx}}$ J. 8. Fundus apparently healthy as seen through cataractous lens. The right eye was also cataractous, but the fundus could be indistinctly seen. The nerve seemed normal, its vessels were of fair size, it was pale, tending to be cupped, and surrounded by a narrow posterior staphyloma. There was a distinct patch of thin retinitis at the macula, with fine specks of pigment on the retinal vessels. There were also one or two floating specks in the vitreous. Tension was normal, and no indications bore examination in favor of glaucoma.

The right eye was alone affected by seeing—upon opening and closing—faces looking at her of squirrels, owls, and less clearly of men, never two alike, and never suggesting known characters. This symptom had existed for some months, and disappeared during sleep and with closed right eye. She described metamorphopsia, but it was absent at my examination.

Case II.—Mrs. S., aged seventy, complained of scintillations of light, and of having seen more or less constantly for several months large faces on the wall. The faces were generally in profile, bearing some resemblance to one another, rarely to be recognized, but occasionally suggestive of some known person. The faces were present at all times of the day when her eyes turned toward the wall. Vision was reduced to barely J. 20 by large patches of choroido-retinitis with atrophy, the disks were pale, and the vessels small. The media were perfectly healthy. Despite the failure of vision Mrs. S. wrote quite legibly. There was nothing in the past history throwing light upon the case. Both these ladies were sensible, and used every suggestion given to rid them of the illusion, but I obtained no satisfactory result from a short course of treatment in either case.

An interesting series of symptoms in fatigue of the visual nervous system is reported by Richard Hilbert (*Klin. Monats. f. Augenheilk.*, 1884):

"(1) After a sleepless night H. found that, on looking at a white surface, the field of vision was subject to alternate flashes of light and obscurations synchronous with the pulse beat. (2) On looking at print the letters seemed some in front and some behind the paper; paving stones appeared on a different level in the street. (3) The interspaces between the paving stones appeared red. This condition of *erythropsia* occurred with various degrees and directions of light; it was present with one or both eyes open, with closed eyes it was never perceptible."

The symptoms were considered due to general nervous exhaustion, with hyperæsthesia of the visual nervous system in the brain; and reasons are adduced for preferring this central hypothesis in erythropsia, rather than explaining it by retinal fatigue; but the latter cause seems at least equally probable. No abnormal condition of the eyes could be detected during the attack; with the exception of slight myopia, they were objectively normal.

Chromophobia is a term applied to cases of special hyperæsthesia in which some particular color causes intense worry to the patient, who may, for instance, be made miserable by seeing a piece of red blotting-paper.

Whatever may be the relative bearing of the peripheral sense organ, or of the central sense organ, in a given case of impairment or illusion of vision, the optic nerve itself when stimulated merely gives rise to a sensation of light. Sensations of light are well known to be excited independently of ordinary impressions from external luminous objects; some are altogether the result of disease in the optic apparatus. The word *photopsia* best expresses this subjective feeling of "visus lucidus."

Case III.—A lady, aged forty-six consulted me on account of most severe attacks of light *glare*. The left eye had been removed twelve years before for recurrent attacks of inflammatory glaucoma. The right eye then began to give trouble; an iridectomy was done eight years ago with a good result; a second operation was required two years later; and a year after this very little vision remained. The "glares" first began in April, 1885; they have continued to cause her the greatest worry and inconvenience on every other day, almost without intermission up to the present time. In July, 1885, there was perception of candle light. The patient says that she feels in the morning that the glare is coming on; about noon a sheet of light gradually spreads in front of her as if the outer world had become bright, and continues with little variation in intensity all day; if she falls asleep, as she often does, the attack is gone on waking, but it gradually reaches its former intensity. It usually gets rather worse toward dusk, and she wonders why people want lamps. The attacks recur every second day, the sight then seems very bright in contrast with other days when it seems dull; no objects are ever seen, but slight dazzlings occur, with green, red, and purple colors.

When I saw her first in April, 1886, I found the right eye shrunken, with much diminished tension, and subacute hyperæmia of the tunics. The cornea, entirely replaced, except at the periphery, by a thick sclerosis in which the iris seemed implicated, was flattened, and no anterior chamber existed. Perception of light was entirely gone. The glare was distinctly referred to this eye, which became weak and red during the attack. She has led an active life, but for years has been liable to attacks of slight weakness of the left side, lasting only a few minutes, which are induced by slight sudden shocks. Her heart was easily upset. There had never been any indication of migraine, no frontal headache, hemicrania, nausea, or sickness, nor were there any special symptoms before or after the attacks of "eye-glare." These had first commenced long after the age usual for migraine, in which also the scintillating scotoma usually lasts for only an hour or so. The hemiplegic attacks mentioned had been definitely called hysterical; the patient was certainly hyperæsthetic. There was no definite pain in the eye.

The continuous character of the glare is more in accordance with a continuous irritation of the optic nerve producing a condition at the cerebral cortex which culminated in the mental impression complained of, than that it was primarily due to blood changes in the central organ, or nerve discharges from it, which would cause more inconstant and transient light seizures.

Charpentier (*Archives d'Ophthalmologie*) remarks, as the result of experiments, that the sensation of light is produced by the excitation of other elements than those set in action when distinct vision or the sensation of color is elicited.

The light sense is pretty equally distributed throughout the visual field, and possibly depends on the evenly arranged hexagonal pigment cells.

In the case mentioned, the glare had commenced about the time the eye was distinctly degenerating, and also when the patient (who at this time had only bare knowledge of the position of light) was becoming hopeless as to return of sight.

The "longing to see" might have influenced her over-sensitive brain to be unduly active to the subjective impressions received from the hexagonal cells, or whatever may be the physical basis for the light sense, within her irritated and disorganizing eyeball.

Under treatment directed to the patient's general health, improvement is beginning to be felt, but the "glare" still comes on every second day, although in distinctly less amount, sometimes scarcely at all, as I gather from letters. I attribute the photopsia to the condition of the eye, because the eye is always more hyperæmic and damp during the attack; it only then feels distinctly "weak" to the patient—she herself refers the conditions solely to the eye; and lastly because cocaine has given such marked relief that she always keeps it close to her on "glare days" so as frequently to apply it.

The misery caused by the glare was such that, had no improvement followed general treatment, the patient would have submitted to removal of her only eye if she could have been reasonably assured that this would give a fair prospect of relief.